{DESCRIPTION}

{Title of Invention}

COMPOSITE REINFORCING MATERIAL AND METHOD OF PRODUCING A COMPOSITE REINFORCING MATERIAL ~~MOLDING MATERIAL~~

{Technical Field}

{0001}

The present invention relates to a composite reinforcing material and a method of producing a composite reinforcing material~~a molding material~~.

{Background Art}

{0002}

In recent years, addition of various nanomaterials has been studied for purposes of downsizing and weight saving in various fields. In particular, for environmental or resource problems, carbon materials such as graphene, CNT (carbon nanotube) and fullerene have attracted attention as nonmetal nanomaterials, and a resin composite reinforcing material in which a reinforcing material (a filler) is dispersed in a resin for a purpose of improving physical properties of the resin (tensile strength, elastic modulus, etc.) has been proposed.

For example, a resin composite reinforcing material in which a carbon material such as flaked graphite is added to a thermoplastic resin such as polyolefin has been disclosed (Patent Literature 1). Further, a composite reinforcing material having flaked graphite and an inorganic filler added

could be improved. Moreover, it was found that the composite reinforcing material could be produced without substantially changing a conventional production method.

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The invention has been completed focusing on such problems and ~~an object~~embodiments of the invention ~~is~~ seek to provide a composite reinforcing material and a molding material excellent in mechanical strength.

~~Another object~~Embodiments of the invention ~~is~~ also seek to provide a composite reinforcing material capable of exhibiting desired characteristics even though an amount of graphene-like graphite dispersed/added in a base material is small.

~~Yet another object~~ Embodiments of the invention ~~is~~ seek to provide a composite reinforcing material excellent in mechanical strength by using a conventional production process.

{Solution to Problem}

{0010a}

A first aspect of the present invention provides a method of producing a composite reinforcing material, comprising a step of kneading at least a graphite-based carbon material and a reinforcing material into a base material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate

of the rhombohedral graphite layer and the hexagonal graphite layer, based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$Rate = P3/(P3+P4)\times 100 \cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method.

{0010b}

A second aspect of the present invention provides a composite reinforcing material being produced by kneading at least a graphite-based carbon material and a reinforcing material into a base material, thereby exfoliating a part or whole of the graphite-based carbon material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate of the rhombohedral graphite layer and the hexagonal graphite layer, based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$Rate = P3/(P3+P4)\times 100 \cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method.

{0011}

~~In order to solve the above described problems,~~There is disclosed a composite reinforcing material ~~of the present invention comprises~~comprising at least a reinforcing material, graphene-like graphite exfoliated from a graphite-based carbon material, and a reinforcing material, dispersed in a base material,

the graphite-based carbon material characterized by having a rhombohedral graphite layer (3R) and a hexagonal

{CLAIMS}

{Claim 1}

A composite reinforcing material comprising at least graphene-like exfoliated from a graphite-based carbon material and a reinforcing material dispersed in a base material,

the graphite-based carbon material having a rhombohedral graphite layer (3R) and a hexagonal graphite layer (2H), wherein a Rate (3R) of the rhombohedral graphite layer (3R) and the hexagonal graphite layer (2H), based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$\text{Rate (3R)} = P3/(P3+P4)\times 100 \cdots \text{(Equation 1)}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer (3R) based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer (2H) based on the X-ray diffraction method.

{Claim 2}

The composite reinforcing material according to claim 1, wherein the reinforcing material is a microparticle having a string-like, linear, or flake-like shape.

{Claim 3}

The composite reinforcing material according to claim 2, wherein the microparticle has an aspect ratio of 5 or more.

{Claim 4}

The composite reinforcing material according to claim 1 or 2, wherein a weight ratio of the graphite-based carbon material to the reinforcing material is 1/100 or more and less than 10.

{Claim 5}

The composite reinforcing material according to claim 1, wherein the base material is a polymer.

{Claim 6}

The composite reinforcing material according to claim 1, wherein the base material is an inorganic material.

{Claim 7}

A molding material for use in 3D printing or the like, comprising the composite reinforcing material according to claim 1.

{Claim 1}

A method of producing a composite reinforcing material, comprising a step of kneading at least a graphite-based carbon material and a reinforcing material into a base material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate of the rhombohedral graphite layer and the hexagonal graphite layer, based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$Rate = P3/(P3+P4)\times 100 \cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method.

{Claim 2}

The method of producing the composite reinforcing material according to claim 1, wherein the reinforcing material is a microparticle having a string-like, linear, or flake-like shape.

{Claim 3}

The method of producing the composite reinforcing material according to claim 2, wherein the microparticle has an aspect ratio of 5 or more.

{Claim 4}

The method of producing the composite reinforcing material according to claim 1 or 2, wherein a weight ratio of the graphite-based carbon material to the reinforcing material is 1/100 or more and less than 10.

{Claim 5}

The method of producing the composite reinforcing material according to claim 1, wherein the base material is a polymer.

{Claim 6}

The method of producing the composite reinforcing material according to claim 5, wherein a compatibilizer is added.

{Claim 7}

The method of producing the composite reinforcing material according to claim 1, wherein the base material is an inorganic material.

{Claim 8}

A composite reinforcing material being produced by kneading at least a graphite-based carbon material and a reinforcing material into a base material, thereby exfoliating a part or whole of the graphite-based carbon material,

the graphite-based carbon material having a rhombohedral graphite layer and a hexagonal graphite layer, wherein a Rate of the rhombohedral graphite layer and the hexagonal graphite

layer, based on an X-ray diffraction method, which is defined by following Equation 1 is 31% or more:

$$\text{Rate} = P3/(P3+P4)\times 100 \quad \cdots\cdots \text{Equation 1}$$

wherein

P3 is a peak intensity of a (101) plane of the rhombohedral graphite layer based on the X-ray diffraction method, and

P4 is a peak intensity of a (101) plane of the hexagonal graphite layer based on the X-ray diffraction method.